SUMMARY REPORT OF EPA ACTIVITIES
SWIFT CREEK ASBESTOS SITE
WHATCOM COUNTY, WASHINGTON

U.S. EPA, Region 10 in Cooperation with:

Agency for Toxic Substances Disease Registry
Northwest Clean Air Agency
U.S. Army Corps of Engineers
Washington State Department of Ecology
Washington State Department of Health
Whatcom County Health Department
Whatcom County Public Works

Report Prepared by Ecology and Environment, Inc.
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LIST OF ACRONYMS

Acronym	Definition
ACM	asbestos-containing material
Corps	United States Army Corps of Engineers
E & E	Ecology and Environment, Inc.
EPA	United States Environmental Protection Agency
f/cc	fibers per cubic centimeter of air
HHSV	Human Health Screening Value
ICDD	International Centre for Diffraction Data
mg/kg	milligrams per kilogram
NOA	naturally occurring asbestos
OEA	EPA Office of Environmental Assessment
PCM	phase contrast microscopy
PCME	phase contrast microscopy equivalent
%	percent
PLM	polarized light microscopy
RBC	risk-based concentrations
s/cc	structures per cubic centimeter of air
SEPA	State Environmental Policy Act
START	Superfund Technical Assessment and Response Team
TDD	Technical Direction Document
TEM	transmission electron microscopy
WDFW	Washington Department of Fish and Wildlife
WDOH	Washington State Department of Health
XRD	X-Ray Diffraction

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EXECUTIVE SUMMARY

The United States Environmental Protection Agency (EPA), Region 10 has been investigating the presence of naturally occurring asbestos (NOA) at the Swift Creek Asbestos Site in Whatcom County, Washington, in coordination with the Agency for Toxic Substances Disease Registry; Northwest Clean Air Agency; U.S. Army Corps of Engineers; Washington State Department of Ecology; Washington State Department of Health; Whatcom County Health Department; and Whatcom County Public Works.

At the request of the Whatcom County Health Department, EPA began to investigate the site in 2006. EPA restricted its investigation to the dredged sediments along Swift Creek between Goodwin and Oat Coles Roads. EPA performed three phases of field work at the site in 2006 to further characterize the nature and extent of the asbestos contamination in stockpiled sediments along the creek and to determine the potential health risks to local residents and site visitors. The field events included a site reconnaissance and sampling event in April 2006 to verify the presence and source of asbestos and associated minerals, an Integrated Assessment in May 2006, and activity-based sampling in August 2006. The methods and results of these field events have been presented in several separate reports. This report is intended to provide an overview and summary of EPA's work at the site in 2006.

The results of EPA's April and May 2006 site characterization field events confirmed that asbestos is present in the dredged sediment materials and determined the distribution of asbestos concentration. The average concentration of asbestos in bulk samples collected from dredged sediment at the site was 1.7 percent (%) and ranged up to a maximum of 4.4 %.

To further investigate the potential health risks for visitors to the site, EPA performed activity-based sampling at the site in August 2006. EPA evaluated three scenarios that are typically performed at the site, including loading / hauling dredged material, raking / spreading dredged material, and recreation (e.g., walking, jogging, and biking). The results indicated that there were elevated levels of exposure to asbestos fibers for all three activities evaluated.

EPA then performed a risk evaluation with the results of the activity-based sampling, to evaluate potential long-term health risks for area residents and visitors. The results indicated that typical activities performed at the site, which may also involve the disturbance of the dredged materials, may lead to an increased level of long-term risk.

Because of these potential health risks, EPA recommends that dredged materials no longer be removed from the site without personal protection and that it not be taken to other sites where further exposure is possible. EPA recommends that community education be considered to help prevent or minimize ongoing exposures to residents. EPA will also continue to work with other federal, state, and local agencies to evaluate potential health risks and to develop short- and long-term strategies to address flooding and sediment control in Swift Creek.

1.0 QUESTIONS AND ANSWERS ABOUT EPA'S INVESTIGATION

This section presents the answers to some common questions that local residents, the public, and other interested parties may have about the contamination at the Swift Creek site and the results of EPA's investigations.

Why is EPA involved with the Swift Creek Asbestos Site?

EPA is investigating the Swift Creek Asbestos Site because of potential health risks to residents and other visitors due to the presence of NOA in sediments and dredged material from the creek.

For more details about the background and setting of the Swift Creek Asbestos Site, please see Section 3.0.

What is asbestos?

Asbestos refers to a number of naturally occurring fibrous minerals having long, thin, easily separable fibers. Asbestos fibers typically occur in fiber bundles and have high tensile strength, electrical resistivity, and are resistant to chemicals and heat. Because of these physical characteristics, asbestos has been used as a component of many building materials such as insulation, fire proofing, and floor tiles.

Why is asbestos a health concern?

Asbestos is known human carcinogen and exposures to asbestos may result in potential risks to human health. When asbestos is disturbed, the microscopic asbestos fibers can become airborne and enter people's lungs. Once in the lungs, the sharp, microscopic fibers can lodge into the lining of the lungs which can lead to health problems like asbestosis, lung cancer, and mesothelioma.

What are the types of asbestos?

Asbestos includes the fibrous varieties of two groups of silicate minerals, serpentine and amphiboles. The most common asbestos mineral (in nature and in commercial use) is chrysotile, a fibrous variety of serpentine. Chrysotile fibers are typically more wavy and flexible than other fiber types.

Several amphibole minerals can occur in a fibrous variety with characteristics of asbestos. Some varieties of amphibole asbestos include crocidolite (a fibrous form of riebeckite), amosite (a fibrous form of grunerite), and fibrous forms of tremolite, actinolite and anthophyllite. At a microscopic scale, amphibole fibers can appear straighter and more needle-like than chrysotile fibers. Some scientists believe that amphibole fibers may pose a greater risk of disease than chrysotile fibers.

If a material contains less than 1% asbestos, is it still dangerous?

Most state and federal regulations define "asbestos-containing material (ACM)" as any material that contains more than 1% asbestos. If a material contains more than 1% asbestos, it is considered to be ACM, and specific regulations for the use, management, and disposal of that material are triggered. However, materials that contain less than 1% asbestos may still be dangerous, even though they are not considered to be ACM and may not be regulated as ACM. Studies conducted by EPA and other scientists have determined that disturbance of soils containing less than 1% asbestos can still lead to significantly elevated levels of airborne asbestos fibers.

Is asbestos still dangerous if it is naturally occurring?

Asbestos is a naturally occurring mineral. Most of the concern with asbestos exposure is based on the use of asbestos as a component in building materials found in homes, schools, and other buildings. However, naturally occurring asbestos (NOA) still presents a possible health risk. When considering whether asbestos fibers can become airborne and pose a possible health risk to humans, it does not matter if the asbestos is found naturally in soils or sediments or was placed into a manufactured building material. Asbestos fibers can be present in materials at levels that are potentially dangerous, even though they may not be visible to the human eye.

What has EPA done at the site so far on this project?

In April 2006, EPA collected samples for mineralogical analysis to characterize the mineral composition of Swift Creek sediments and dredge piles and to verify the occurrence of chrysotile asbestos.

In May 2006, EPA collected samples of the dredged creek sediments to further estimate the amount of NOA in the sand and gravel.

In August 2006, EPA performed Activity-Based Sampling at the site to assess the potential health concerns to residents and workers exposed to the dredged material.

What were the results of the May 2006 characterization work?

The results of EPA's May 2006 site characterization field event confirmed that asbestos is present in the dredged sediment materials and determined the distribution of asbestos concentration. The average concentration of asbestos in samples collected from the site was 1.7 % and ranged up to a maximum of 4.4 %.

For more details about the May 2006 site characterization event, please refer to Section 4.0.

What is a risk evaluation?

A risk evaluation report is based on risk assessment techniques. EPA scientists often use risk assessment techniques to determine whether the level of contamination at a particular site represents an increased level of risk to people that work, live, or recreate in a contaminated area. The risk assessor combines information about the toxicity of the contaminant with information about the extent of people's exposure to that contaminant to estimate potential health hazards or cancer risks posed by the exposure.

What is the advantage of doing a risk evaluation with data from activity-based sampling?

As described above, risk evaluations are usually based on a certain number of assumptions, such as the level and duration of exposure to the contaminant. By using data collected during activity-based sampling, EPA's risk assessors are able to work with more representative human exposure data (e.g., air in the breathing zone of a person), and therefore they are able to provide better estimates of exposure for use in the risk evaluation.

What was the activity-based sampling that occurred in August 2006?

Activity-based sampling is a site investigation technique that EPA uses to evaluate potential exposure risks at contaminated sites. EPA has performed similar investigations at other asbestos sites located throughout the country. Activity-based sampling is designed to provide EPA scientists and risk assessors with site-specific data about exposure levels for common activities that might be performed by residents and visitors at the site.

For more details about activity-based sampling, please refer to Section 5.0.

What were the scenarios used for the activity-based sampling of dredged materials at the Swift Creek Asbestos Site?

EPA selected three scenarios, based on consultation with local government about typical activities performed at the site:

Loading / Hauling
Raking / Spreading
Walking / Jogging / Biking

These scenarios represent common activities that have been performed at the site and which also may lead to elevated exposure levels to asbestos.

What were the results of the activity-based sampling?

The results of the activity-based sampling performed at the Swift Creek Asbestos Site indicated that there were elevated levels of exposure to asbestos fibers for all three activities evaluated.

For more details about the results of the activity-based sampling at the Swift Creek Asbestos Site, please refer to Section 6.0.

What were the results of the risk evaluation?

The results of the risk evaluation indicated that the activities evaluated by EPA at the Swift Creek Asbestos Site may lead to an increased level of long-term health risk. The activities evaluated by EPA included the activities performed in the activity-based sampling (e.g., loading, raking, and walking) and other extrapolated activities (e.g., farming, gardening, and child's play). Other activities performed in the area of the contaminated materials will also likely be associated with increased exposure to asbestos and increased long-term health risk.

For more details, please refer to Section 7.0.

What are some of the uncertainties about this risk evaluation?

There are inherent uncertainties about any site investigation, including the activity-based sampling performed by EPA. For example:

- EPA estimated exposure levels based on the best assumptions, but the scenarios performed during the study may not exactly match how site visitors will perform the activities.

- The study did not assess all types of possible exposure. Because of the wide range of possible human activities that may be performed at the site, it was not feasible to evaluate all of them.

2.0 INTRODUCTION

The United States Environmental Protection Agency (EPA), Region 10 has been investigating the presence of NOA at the Swift Creek Asbestos Site in Whatcom County, Washington.

This investigation began at the request of the Whatcom County Health Department (see more information about this in Section 3.2.). In 2006, EPA performed three phases of field work at the site to further characterize the nature and extent of the asbestos contamination in stockpiled sediments along the creek and to determine the potential health risks to local residents and site visitors. The field events included a site reconnaissance and sampling event in April 2006 to verify the presence and source of asbestos and associated minerals, an Integrated Assessment in May 2006, and activity-based sampling in August 2006. The methods and results of these field events have been presented in several separate reports (Januch 2006, Januch, Frank, and Edmonds 2006, E & E 2006, OEA 2006, and Wroble 2007). This report is intended to provide an overview and summary of EPA's work at the site in 2006.

EPA has tasked Ecology & Environment, Inc. (E & E), under Superfund Technical Assessment and Response Team (START)-3 contract number EP-S7-06-02, to prepare this summary report under Technical Direction Document (TDD) 06-12-0026.

This sampling investigation has been coordinated with the following agencies: Agency for Toxic Substances Disease Registry; Northwest Clean Air Agency; U.S. Army Corps of Engineers; Washington State Department of Ecology; Washington State Department of Health; Whatcom County Health Department; and Whatcom County Public Works.

2.1 SITE LOCATION AND DESCRIPTION

The Swift Creek Asbestos Site is located along the banks of Swift Creek between Goodwin and Oat Coles Roads in Whatcom County, Washington, near the towns of Nooksack and Everson (Figure 2-1). Swift Creek begins on Sumas Mountain and discharges to Sumas River. Asbestos has been found in sediments all along the creek and in the Sumas River. Therefore, asbestos in sediment is not confined to the section of Swift Creek located between Goodwin and Oat Coles Road; rather, that section of the creek was selected as the site for EPA's investigation because it had been recently dredged.

The land surrounding the Swift Creek Asbestos Site is used for agricultural and residential purposes. The source of the asbestos is a landslide located approximately 1.7 miles upstream from Goodwin Road near the headwaters of Swift Creek (Figure 2-2). Figure 2-3 presents an oblique view of the site.

For additional information beyond what is summarized in this section, please refer to the Swift Creek Asbestos Integrated Assessment (E & E 2006).

2.2 SITE HISTORY

Historically, there have been many landslides in the Swift Creek drainage area to the east of the site. The excessive sediment in Swift Creek is caused by the large, complex landslide in the upper watershed of Sumas Mountain that reactivated in the 1940s. Approximately 150,000 cubic yards of material moves into the creek system annually, and this is expected to continue for the next 400 to 600 years (Pittman 2006). The exposed slide material contains naturally occurring asbestos and the following associated metals: nickel, manganese, cobalt, chromium, and magnesium.

To prevent flooding, Swift Creek has been dredged frequently and the dredged material has been placed on the banks of Swift Creek. U.S. Army Corps of Engineers (Corps) and Whatcom County records contain incomplete information about how often and when this has occurred, but it is believed that Swift Creek has been dredged since the late 1940s. Whatcom County dredged the Creek in full compliance with the Washington Department of Labor and Industries, who performed consultative air monitoring for employee activities. In 1995, as part of the State Environmental Policy Act (SEPA) approval process for flood control dredging, an interagency study determined the creek sediments contained less than one percent asbestos by weight overall. Best management practices were established for workers doing dredging activities.

Until 2005, the material dredged from Swift Creek was removed throughout the year by various entities, likely including local businesses and residents, and likely used as fill material.

2.3 RECENT WHATCOM COUNTY PERMIT ACTIONS

This section describes recent actions by Whatcom County with regard to obtaining and complying with permits from the Corps to dredge Swift Creek. Department of the Army permits were issued under authority of Section 404 of the Clean Water Act. These actions have led to dredged sediments currently being stored along the banks of Swift Creek and EPA's involvement at the site.

On September 14, 2004, the Washington Department of Fish and Wildlife (WDFW) responded to the Corps' Public Notice for Whatcom County's July 15, 2004, permit application (Permit #: 200400254) to construct two sediments traps on Swift Creek. The WDFW stated that the County's plans for control of the contaminated sediments removed from the creek channel were not sufficient to ensure that the material would not be used for another project and potentially re-enter waters of the state. (Perry 2006)

In September and October 2004, Whatcom County Public Works stated (in part) that the following measures would be taken: 1. Material excavated from the creek channel will be stockpiled; 2. The county will provide lockable gates for the storage areas and require that a county permit authorize the use of the material; and 3. Appropriate signage will be placed at the stockpile locations that will state that the material is "not to be used as fill in areas where it could enter surface waters of the state." (Perry 2006)

As a result, the Corps added the following special condition to Whatcom County's permit to construct two sediments traps on Swift Creek:

> Prior to undertaking sediment removal for construction of the sediment traps, a sediment storage and handling plan must be submitted to the U.S. Army Corps of Engineers. No excavation may be undertaken until the Corps and the WDFW have approved the plan and notified the applicant in writing of its acceptance. (Perry 2006)

The work was not undertaken because the channel area targeted for the sediment trap had accumulated an excessive sediment load.

On May 11, 2005, EPA responded to the Corps' Public Notice for Whatcom County's February 28, 2005, permit application (Permit #200500250) to excavate accumulated sediments and install bank stabilization on Swift Creek. EPA expressed concerns over the presence of naturally occurring asbestos in the excavated material and the potential impacts to public health resulting from the material's use as fill material for upland projects. EPA recommended that: 1. A method of monitoring and tracking the material's use and submission of reports be developed; 2. That there be no minimum threshold for material removed without the need for Whatcom County permitting; 3. That the stockpiled material be secured from unauthorized removal; and 4. That a public information project be developed to inform potential users of the risks associated with naturally occurring asbestos. EPA also stated that the proposed project failed to meet the requirements of the Clean Water Act, Section 401(b)(1) guidelines found in Subpart B, Section 230.11(d), "Contamination Determination", and that no permit be issued until the proposed action meets the requirements and EPA's public and environmental health concerns are addressed. (Perry 2006)

In a June 16, 2005, e-mailed correspondence, Whatcom County Public Works, Rivers and Flood Division stated (in part) that: 1. The Washington State Department of Health (WDOH) would be assisting the County in determining the health risks of the Swift Creek material; 2. The County would keep the material stored on site until the health risks were determined; and 3. The County would formulate a long-term plan for the sediment depending upon the outcome of the WDOH health risk analysis. (Perry 2006)

After reaching agreement with Whatcom County that the excavated material would remain on site until a new review and determination can be made by the WDOH, the Corps added a special condition to the County's requirement that the material must be securely stored on site until a new handling plan, acceptable to the Corps and EPA, had been developed. The special condition added to the permit stated:

> All sediments excavated by authority of this permit must be securely stored at the project site on adjacent uplands. No material excavated from the stream channel may be removed from the site for any use including as fill material. Prior to undertaking excavation and stockpiling work, signed Flood Control Works Agreements from all affected property owners must be submitted to the U.S. Army Corps of Engineers, Seattle District, Regulatory Branch (Corps). (Perry 2006)

The WDOH Draft Health Consultation to address the Swift Creek sediment asbestos was released on November 29, 2005, and the final report was issued on March 31, 2006. The conclusion of this report included the following statement: "An *indeterminate public health hazard* exists from potential exposure to Swift Creek sediments asbestos" (italics in original; WDOH 2006).

In the WDOH recommendations, the report stated: "additional characterization of Swift Creek sediments and downstream portions of Sumas River sediment and surface [water] is necessary to determine health risks." (WDOH 2006)

In February 2006, the Whatcom County Health Department asked the EPA to characterize the sediments in Swift Creek by defining the type and concentrations of asbestos in them. In March 2006, EPA agreed to sample and analyze the sediments dredged and currently stockpiled along Swift Creek in the area of the Creek between Goodwin and Oat Coles Roads.

In June 2006, after EPA's April and May investigation of the Swift Creek sediments, the Whatcom County Heath Department asked EPA to conduct an additional step in this investigation. EPA was asked to conduct activity-based sampling to determine the risk associated with the asbestos found in the sediments.

2.4 SUMMARY OF EPA'S 2006 INVESTIGATION

In 2006, EPA performed several phases of investigation at the Swift Creek Asbestos Site. These phases included:

Site Reconnaissance;
Integrated Assessment;
Activity-Based Sampling and Analysis; and
Risk Evaluation.

The remaining sections of this report discuss the work performed and the results obtained for each of these phases.

Figure 2-1

Figure 2-2

Figure 2-3

3.0 ASBESTOS ANALYTICAL METHODS

PLM, XRD, PCM, and TEM are different methods used to analyze asbestos in various types of materials.

Polarized light microscopy (PLM) is used to analyze the amount of asbestos in bulk materials, such as in building materials, soil, or sediment. EPA used PLM testing to analyze samples of dredged sediment from the Swift Creek Asbestos Site in May 2006. PLM testing is performed with a polarized light microscope, and the results are provided as percent asbestos in the sample.

Powder X-ray diffraction (XRD) is an analytical technique that can be used to help identify and characterize asbestos. Unlike optical microscopy, such as PLM, XRD does not distinguish between fibrous and non-fibrous forms of serpentine and amphibole minerals. Minerals are identified by comparing the diffraction data to reference patterns published by the International Centre for Diffraction Data (ICDD) or by comparison to reference materials. The abundance of the minerals identified by XRD can be estimated from the diffraction peak height and peak area.

Phase-Contrast Microscopy (PCM) is used to analyze airborne fibers collected onto filters. PCM testing detects all types of microscopic fibers, including asbestos, fibrous glass, mineral wool, and organic fibers. However, PCM cannot differentiate between asbestos and other fiber types, so the results are estimates of the amount of asbestos fibers present. PCM testing is performed with a phase contrast microscope, and the results are provided as fibers per cubic centimeter of air (f/cc).

Transmission electron microscopy (TEM) is used to analyze bulk or air filter samples for asbestos. TEM testing is much more sensitive and powerful than either PCM or PLM. Not only can TEM (when coupled with XRD and/or energy dispersive X-ray spectrometry) positively identify asbestos fibers (unlike PCM), it can also provide more detail about the specific types of asbestos fibers detected in a sample. Additionally, TEM can detect different types of microscopic particles, including single fibers, fiber bundles, cluster, or matrices. These objects are collectively known as “structures.” TEM results of air samples are provided as structures per cubic centimeter of air (s/cc).

Both PCM and TEM were used to analyze air filter samples from the Swift Creek Asbestos Site. The advantage of PCM is that it is much less expensive than TEM testing and it can be performed in the field, thus providing field scientists with quick feedback about air contaminant levels. However, as noted above, PCM cannot distinguish asbestos from other airborne fibers. TEM testing is much more powerful and sensitive. Not only can it positively identify asbestos, it can also distinguish between different types of asbestos fibers, it can measure the size and dimensions of each individual asbestos fiber, and it can detect asbestos fibers at much lower concentrations. However, compared to PCM, the TEM method is more expensive, takes longer to complete, and can only be performed in a laboratory.

Because the PCM and TEM methods each offer advantages, EPA used both at the Swift Creek Asbestos Site during the activity-based sampling. The PCM samples were analyzed to provide quick feedback about the levels of contamination and dust that were being generated during the activity-based sampling scenarios. This was especially important to ensure that the TEM samples were not so overloaded by dust that they could not be analyzed. The TEM samples were then analyzed to provide data about exposure levels, which were used in this risk evaluation.

TEM is a more sensitive technique and can measure fibers that are much smaller than PCM. However, most risk models are based upon PCM measurements. Therefore, to use TEM data to determine health risks, it is necessary to evaluate those specific fibers that meet the definition of the fibers measured by PCM. PCM-equivalent (PCME) fibers are those asbestos fibers (analyzed by TEM) that measure greater than 5 microns in length, have a width greater than 0.25 microns, and have an aspect ratio (ratio of length to width) of greater than or equal to 3-to-1. PCME fibers are called that because they are based on the fiber dimensions defined by the PCM method.

4.0 SUMMARY OF EPA SITE RECONAISSANCE, APRIL 2006

EPA conducted a site reconnaissance on Swift Creek on April 6, 2006, to identify the mineralogy and morphology of fine-grained materials in, and stockpiled along, Swift Creek. This work included: 1. Collection of grab samples of material at the Swift Creek site, including sediments and water; and 2. Analyses of the samples by polarized light microscopy (PLM) and X-ray diffraction (XRD) to identify and estimate the abundance of the mineral phases present.

EPA collected twenty-four samples at the Swift Creek site. A sub-set of eight of the twenty-four samples was chosen and submitted for analysis by stereomicroscopy and PLM, and 13 of the samples were submitted for XRD analysis.

4.1 RESULTS OF PLM ANALYSIS

Chrysotile asbestos was detected in all of the samples ranging in estimated concentration of <1% (trace) to approximately 30%. The full report for this work is provided in Appendix A, including photomicrographs of suspect or confirmed chrysotile asbestos fiber bundles. (Januch 2006)

4.2 RESULTS OF XRD ANALYSIS

The full report of the XRD results is provided in Appendix B. The XRD analysis revealed the serpentine detected in the samples consists of a mix of chrysotile and lizardite derived from the landslide of altered serpentinite. Lizardite and chrysotile (magnesium silicate hydroxides) comprise two of the three more common members of the serpentine group. An asbestiform component of chrysotile occurs in these samples based on the above PLM analysis, but other chrysotile habits are also present. Consequently, not all of the chrysotile identified by XRD for this project is asbestos. (Januch, Frank, and Edmonds 2006)

The serpentine is well-mixed with hydroxy minerals, including brucite (magnesium hydroxide) and coalingite and pyroaurite (magnesium iron hydroxy carbonates). Magnetite (iron oxide) also occurs throughout the samples in trace amounts. Other minerals also occurring in variable amounts include chlorite, mica, quartz, feldspar, pyroxene, amphibole, calcite, heulandite zeolite, and chromite. (Januch, Frank, and Edmonds 2006)

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5.0 SUMMARY OF EPA INTEGRATED ASSESSMENT, MAY 2006

An Integrated Assessment is a type of EPA site investigation. EPA has several Superfund programs that assess contaminated sites to determine what clean-up actions may be warranted. One such program, the Site Assessment Program, determines whether a site is a candidate for the National Priority List, which is typically reserved for larger, more complex sites that will require long-term remedial clean-up strategies. Another clean-up program is the Removal Program, which is designed to perform time-critical and smaller, non-time-critical clean-ups. Typically, one EPA program will investigate a site at any given time. However, sometimes EPA decides to investigate a site against the actionable criteria of both programs because a particular site may have conditions that qualify it for each. An Integrated Assessment is a technique that EPA uses to evaluate a site through both programs simultaneously. For more information, please refer to the Swift Creek Asbestos Integrated Assessment (E & E 2006).

5.1 SUMMARY OF METHODS

Previous investigations have indicated that Swift Creek has higher concentrations of asbestos fibers than upgradient streams in the Sumas River drainage basin. In May 2006, personnel from EPA and its START contractor collected 70 soil and 26 air filter samples as part of the Swift Creek Integrated Assessment. The site is the location of dredged materials along the banks of Swift Creek that contained asbestos. The Integrated Assessment involved the collection of 13 grab surface material samples, 38 composite subsurface material samples, and 26 air filter samples. Samples were collected from the two dredged material piles, one on the north side of Swift Creek and one on the south side of Swift Creek between Oat Coles and Goodwin Roads.

5.2 SUMMARY OF RESULTS

The on-site surface soil samples contained asbestos in concentrations ranging from 0.1 to 4.4%. The overall asbestos concentration in the dredge material samples was 1.7%.

The samples also contained elevated concentrations of metals. Chromium ranged from 205 to 299 milligrams per kilogram (mg/kg); nickel ranged from 1,420 to 1,750 mg/kg, and vanadium ranged from 24 to 34 mg/kg. These results were compared to EPA Region III Risk-Based Concentrations (RBCs) for residential soil (EPA 2006), EPA Region VI Human Health

Screening Value (HHSV) limits for residential soil (EPA 2005), and natural background concentrations for the Puget Sound area and the State of Washington (Ecology 1994). The results for chromium, nickel, and vanadium exceeded one or more of the regulatory and/or background values.

EPA also collected air filter samples during the sediment collection activities. Seven of the samples, including four personal and three stationary samples, were analyzed at a commercial laboratory. All of the samples analyzed contained a detectable concentration of asbestos fibers. In the personal samples, the concentration of phase contrast microscopy-equivalent (PCME; explained in Section 5.3) fibers ranged from 0.009 to 0.056 s/cc, with an average concentration of 0.036 s/cc. In the stationary samples, the concentration of PCME fibers ranged from not detected (less than 0.00087 s/cc) to 0.0014 s/cc, with an average concentration of 0.0010 s/cc. The average concentration for the personal samples was over 10 times greater than the average concentration of the stationary samples.

The Integrated Assessment concluded that the dredged material piles at the site were contaminated with asbestos and metals and that people working or traveling across the site are potentially exposed to these contaminants. The report also concluded that the asbestos could be migrating to off-site locations, including nearby residential areas.

6.0 ACTIVITY-BASED SAMPLING

6.1 EXPLANATION OF ACTIVITY-BASED SAMPLING

Activity-based sampling is a site investigation technique that EPA uses to evaluate potential exposures at contaminated sites. EPA has performed similar investigations at other asbestos sites and a few lead-contaminated sites located throughout the country.

Activity-based sampling is designed to give EPA scientists data about levels of asbestos exposure during common activities that may be performed at the site. During activity-based sampling, EPA workers simulate tasks involving some level of disturbance of the dredged material at this site. While performing these tasks, the workers wear air sampling equipment in their breathing zone and protective equipment, including respirators.

Air samples are collected by passing air through a filter for a specific period of time. The filter that is used is specifically designed to collect asbestos fibers. The samples are then collected and submitted for analytical testing in accordance with industry-standard testing methods, such as PCM or TEM.

The results of the analyses indicate the concentration of airborne asbestos fibers that the worker was exposed to during the scenario. Once these results are obtained, they can be used in a risk evaluation to calculate current and potential future estimated exposure risks for residents and visitors to the contaminated area.

The activities that EPA performed at the Swift Creek Asbestos Site included loading / hauling, raking / spreading, and recreation (walking / jogging / biking). EPA selected these scenarios based on consultation with local government. These scenarios are representative of common activities that have been performed at the site and which also may lead to elevated exposure levels to asbestos.

6.2 SAMPLING METHODS

During the activity-based sampling at the Swift Creek Asbestos Site, EPA collected personal and stationary air samples. Personal air sampling is performed by placing an air sampling pump on a worker, with the air inlet placed near the person's breathing zone. This type of sample can provide data about the specific levels of contamination to which a person may be exposed during a specific period of time.

Stationary air sampling is performed by placing an air sampling pump at a fixed location for a specific period of time. The air inlet is usually held up by a tripod or similar piece of equipment at a height that is comparable to a person's breathing zone. Unlike a personal air sampler, a stationary sampler stays fixed in one location.

Stationary air sampling can provide important data about ambient concentrations of air contaminants, and it can also provide data about potential exposure levels to nearby bystanders who may be adjacent or downwind of site activities. However, stationary air sampling may not provide the best data about the types of exposures that a person might experience when moving or performing activities inside the contaminated area. When a person moves, he or she may be moving into zones with different levels of contamination. Also, a person is likely to increase the level of airborne contaminants that they are exposed to by disturbing the contaminated material while moving. Therefore, personal air sampling can provide more accurate data about the types of exposures that a person might encounter when moving through or working in a contaminated area.

6.3 RESULTS OF ACTIVITY-BASED SAMPLING

For more information, please refer to the report titled Activity-Based Sampling at The Swift Creek Asbestos Site (OEA 2006), which is included as Appendix C.

On August 21-25, 2006, the EPA Region 10 Office of Environmental Assessment conducted activity-based sampling at Swift Creek in Whatcom County, Washington. The objective was to provide data to evaluate the potential risks to human health associated with activities involving disturbance of dredged material from Swift Creek. The tasks required to achieve this objective were to:

- Collect personal air monitoring samples during activities including loading and unloading of dredged materials, raking or spreading the dredged material, and walking or bicycling on the dredged materials and creek bed.
- Collect stationary air samples around the perimeter and upwind and downwind of each activity location.
- Screen filters by phase contrast microscopy (PCM) and analyze filters by transmission electron microscopy (TEM).
- Collect soil moisture and meteorological data during activities.

Chrysotile fibers were detected in every personal and stationary air filter sample collected during activity-based sampling. A small number of amphibole (actinolite or tremolite) fibers were also detected in some of the samples. The majority of the chrysotile fibers were relatively short and thin, and therefore not in the PCME size range, but there were still enough in the PCME size range to present a potentially elevated risk.

The personal air monitoring samples had greater concentrations of airborne asbestos fibers than the stationary samples. Generally, the concentrations of asbestos detected in the stationary samples were at least ten times lower than the personal air monitoring samples. This finding is in agreement with other EPA field studies which have demonstrated similar results.

The weather during the sampling was dry with relatively light winds out of the southwest. The perimeter samples collected downwind from the activity generally had higher concentrations of asbestos fibers than the perimeter samples that were stationed upwind.

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7.0 RESULTS OF RISK EVALUATION

For more information about EPA's risk evaluation, please refer to the report titled Risk Evaluation for Activity-Based Sampling Results, Swift Creek Site, Whatcom County, Washington (Wroble 2007), which is included as Appendix D.

7.1 INTRODUCTION

This risk evaluation is based on risk assessment techniques. Risk assessment is a technique that scientists can use to estimate possible exposure levels of a person to a contaminant. The typical risk assessment is based on the toxicity of the contaminant and the extent of exposure. Asbestos is a known human carcinogen; therefore, at Swift Creek, excess lifetime cancer risk is the appropriate health endpoint to evaluate. Excess lifetime cancer risk is typically expressed as the likelihood of the individual to develop the symptom or disease (e.g., cancer) associated with the contaminant. The risk level is typically expressed as 1×10^{-X} or a "one in 10^{X} chance" of developing the disease. A risk level of 1×10^{-4} means that the person has a one in ten thousand (10,000) likelihood of developing the disease, while a risk level of 1×10^{-6} means that the person has a one in one million (1,000,000) likelihood of developing the disease.

EPA's Superfund program considers the acceptable upper range for excess lifetime cancer risk to be between 1×10^{-4} and 1×10^{-6}. Any risk level below 1×10^{-6} is considered to be *de minimis*. A risk level greater than 1×10^{-4} is considered to be higher than EPA's guidelines for acceptable risk and may form the basis for a clean-up action. The Washington State Department of Ecology generally uses a maximum level of risk of 1×10^{-6} for residential exposures and 1×10^{-5} for industrial exposures.

When performing the risk evaluation, EPA not only looked at the three specific activities that were simulated during activity-based sampling, but also at other similar activities. For example, EPA estimated that the types of exposure obtained during the dredging / hauling activity might be similar to the types of exposures that might be obtained during farming or similar tasks that involve disturbing soil. For the shoveling / raking activity, EPA estimated that gardening and a child playing in the soil presented similar exposures. The walking / biking activity was compared to recreational walking along the creek and the use of the area for training by a local high school cross-country team.

7.2 RESULTS

The results indicate that, for all activities evaluated, the risk levels exceeded 1×10^{-6}. For some activities, risk levels exceeded 1×10^{-4}. The highest risk was associated with dredging / hauling for 25 years which assumes that a worker may perform this task for eight hours a day and 30 days a year for 25 years. The risk associated with this scenario had an average risk value of 2×10^{-4}. The average risk values for the farming and gardening scenarios also exceeded 1×10^{-4}. All other scenarios evaluated, including dredging and hauling for only one year, child's play, walking, and cross-country training, had average risks that exceeded 1×10^{-6}.

These results present the estimated risks for some typical activities that may be performed in the Swift Creek area. However, not all activities that could potentially occur in proximity to Swift Creek dredged materials were evaluated. It is possible that individuals that live near the Swift Creek site have exposures to asbestos from the dredged materials that have not been assessed by EPA during this risk evaluation. Additional exposure pathways may result in increases in excess lifetime cancer risk.

7.3 RECOMMENDATIONS

Residents living near the Swift Creek Asbestos Site should limit exposure to Swift Creek dredged materials and associated asbestos fibers. EPA is also concerned that people may contact materials that have been moved from the Swift Creek dredge piles to other locations in Whatcom County. Contact with these materials may also result in exposures to asbestos fibers, but because the type and duration of the exposure will vary for different people, it is difficult to estimate the extent of exposure. Risk from asbestos exposure increases with higher concentration, greater frequency and duration of exposure, and time elapsed since first exposure. Additional sampling at other areas could be used to assess risks at locations remote from the Swift Creek Asbestos Site.

8.0 CONCLUSIONS

The results of EPA's investigations at the Swift Creek Asbestos Site have demonstrated that the dredged sediment materials contain a significant amount of asbestos, averaging 1.7% by weight, and that disturbance of the materials can lead to elevated airborne concentrations of asbestos fibers. The results of the risk evaluation indicate that activities at the site can lead to elevated risk from exposures to asbestos greater than what is considered acceptable under State and Federal regulatory guidelines.

Given the ongoing exposures that may occur near the site and the demonstration that fibers are released into the breathing zone upon disturbance, EPA recommends that dredged materials no longer be removed from the site without personal protection and that it not be taken to other sites where further exposure is possible, as has been done in the past. Community education should be considered to help prevent or minimize ongoing exposures to residents.

A multi-agency approach is needed to address management of current and future dredged sediments from Swift Creek. EPA and other federal, state, and local agencies are working together to:

- Determine what additional environmental and/or human health assessment work is appropriate in this area, and how to accomplish this work;
- Find a short-term solution that will allow Whatcom County to dredge Swift Creek this summer to prevent flooding next fall and winter; and
- Develop safe, long-term solutions for flood control and management of dredged sediments from Swift Creek.

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Appendix A

Case Narrative for Asbestos Analysis by Stereomicroscope and Polarized Light Microscopy for Samples from Swift Creek, April 2006 (Januch 2006)

Appendix B

Trip Report and X-ray Diffraction Analysis of Samples Collected April 6, 2006, Project Code ESD-122A, Swift Creek Asbestos Project (Januch, Frank, and Edmonds 2006)

Appendix C

Activity-Based Sampling at the Swift Creek Asbestos Site, August 21-25, 2006
EPA Office of Environmental Assessment
(OEA 2006)

Appendix D

Risk Evaluation for Activity-Based Sampling Results, Swift Creek site, Whatcom County, Washington
Julie Wroble, EPA Toxicologist
(Wroble 2007)